Climate Change Adaptation in the Perspectives of Food, Energy Crisis and Environmental Degradation for Food Sovereignty in Indonesia

Rahim Darma (Corresponding author)
Center for the Research and Development of Management and Development, Hasanuddin University, Makassar, 90245, South Sulawesi, Indonesia
Tel: +62-811460469 Fax: +62-411582255 E-mail: *rdarma@indosat.net.id*

Rahmadanih
Department of Agricultural Socio-Economics, Faculty of Agriculture, Hasanuddin University, Makassar, 90245, South Sulawesi, Indonesia
Tel: +62-8124232745 Fax: +62-411-586014 E-mail: *rahmadani.sosek@yahoo.com*

Nixia A. Tenriawaru
Department of Agricultural Socio-Economics, Faculty of Agriculture, Hasanuddin University, Makassar, 90245, South Sulawesi, Indonesia
Tel: +62-8134260046 Fax: +62-411-586014 E-mail: *nixia_gany @yahoo.com*

Riri Amandaria
Faculty of Political and Social Sciences, University of Musamus Merauke, Papua, Indonesia
Tel: +62-9713306515 Fax: +62-971325976 E-mail: *riri_amandaria@yahoo.com*

Abstract: The influential factors that have been identified to influence the food crisis energy as well as climate changes are population growth, economic growth, and social conditions. Local food development and food industrialization movement is the approach to overcome food and energy crisis as well as to reduce the GHG emissions. Promoting food industrialization for food sovereignty is a strategic effort for the vulnerability in agricultural sector. Climate change due to the greenhouse effect is caused by the consumption of fossil fuel that continues to rise due to the increased use of vehicles and electrical energy driven by fuel and electricity price subsidies. Fossil fuel subsidy amounting to 19 % of total government spending was mostly or about 84 percent of total subsidies enjoyed by 40 % of high level income of fossil fuel consumers. Approximately 10 % of richest fuel consumers consumed nearly 40 percent of the total subsidized fuel. In contrast, less than 1 %t of the total subsidized fuel used by the poor. There was about 30 % of the fuel consumed is not efficient because of congestion on roads due to the increasing number of vehicles, damaged roads, and urbanization. In addition, the use of energy subsidy inhibits the programs of alternative energy diversification and the investment for renewable energy. Fossil fuel subsidies should be removed and transferred to food subsidy to encourage the increase of local food production that supports diversification and food sovereignty.

Keywords: Food industrialization; local food development; climate change; green house emission

1. Introduction

Climate change or irregular season variation would affect to the change of agricultural ecosystem and human life, especially people in developing countries with the lack condition of socio-economic and highly dependent on the agricultural sector. One of the causes of climate change is the effect of greenhouse gases when the thermal radiation from the surface of atmosphere dispersed back into all directions due to gas levels in the atmosphere are increasing and causing global warming.

The use of fossil fuels produces carbon dioxide (CO^2), nitrogen oxides (NOx), and sulfur dioxide (SO^2), which causes air pollution and green house gas levels in the atmosphere result in global warming. Part of NOx, SO^2, and CO^2 emissions are emitted from the burning of fossil fuels. In addition, emissions of methane are derived from unburned natural gas that also causes global warming. Indonesia has a significantlevel of greenhouse gas (GHG) emissions resulting from the combustion of fossil fuel consumption (Burniaux and Chateau, 2011). The largest fossil fuel consumption is coming from electric power and transportation sector which contribute to green house gas emissions (Koch *et al.,* 2010).

Based on these issues, local food diversification is an approach focused on efforts to overcome food and energy crisis as well as to reduce GHG emission. Implementation of the policy is expected to be a strategy to control urban environmental problems originating from the transportation sector, to reduce fossil fuel consumption by increase energy resource alternative, convert fuel subsidies to local food production, and develop food industrialization to promote food sovereignty as a climate change adaption for the vulnerability in agricultural sector.

2. Climate Changes Adaptation and Socio Economic Factors

Climate change or irregular season variation would affect the agricultural ecosystem and human life, especially people in developing countries with the lack condition of socio-economic and highly dependent on the agricultural sector. One of the sources of climate change is the effect of greenhouse gases when the thermal radiation from the surface of atmosphere dispersed back into all directions because gas levels in the atmosphere increase and cause global warming.

Based on these issues, local food diversification is an approach focused on efforts to overcome food and energy crisis as well as to reduce GHG emission. Implementation of the policy is expected to be a strategy to control urban environmental problems originating from the transportation sector, to reduce fossil fuel consumption by increasing energy resource alternative, convert fuel subsidies into local food production, and develop food industrialization for promoting food sovereignty as a climate change adaption for the vulnerability in agricultural sector.

There are three factors that affect food-energy crisis and GHG emissions, namely population growth, economic growth, and social factors that can be identified as elements of a system. If one of element has changed, it will result in a significant impact on other elements of the

system that ultimately change the structure of the overall system (Marten, 2005). By using Marten framework and analyzing the interrelated factors to overcome food crisis and GHG emissions. Climate change adaptation on food industrialization for food diversification, food sovereignty, natural resource conservation, and sustainable development could be described.

Population Growth

The problem of population growth is to lead the urbanization driven by urban industrial agglomeration, urbanization, and the increasing number of vehicles causing traffic congestion in almost all major cities and metropolitan cities in Indonesia. High levels of congestion in urban encourages inefficient fossil fuel consumption, so fuel use increased by about 30% of normal use due to congestion occurring in urban areas. As a leverage point, the population growth could be measured as "the structure of material stocks and flows and intersection nodes" which is described by Meadows as a 10th from 12th based its efficiency. Meadows (1999) also states that this system may have enormous effect on operations, but it may be difficult to change.

The projection of the total population of Indonesia will always increase in the next 25 years, from 205 million in 2000 to 240 million in 2010 and 273 million in 2025. Despite of its population, the average of Indonesian population growth will decrease during 2000-2025 year period. Population grew at 1.49% per year in 1990-2000 periods, and declined to 1.33% per year in 2000-2005, and 0.92% per year in 2020-2025 (Central Bureau of Statistics Indonesia, 2010).

One of the characteristics of Indonesian population is an unequal growth between islands and provinces. Most of the Indonesian population concentrates in western part of Indonesia, especially in Java Island, even though the total land area is less than 7% from the total land area of Indonesia. The Indonesian population percentage that lives in Java Island is about 60% in year 2010 (Central Bureau of Statistics Indonesia, 2011). Thus, the imbalance factor of population density focused in Java and other big cities road congestion has led to the consumption of fossil fuel and greenhouse gas.

Economic Growth

Economic growth and environmental preservation an effort is a trade off as the use of fossil fuels continues to rise in triggering the economic growth, climate change, and environmental degradation. The use of bio-energy by industrialized countries can indeed reduce the consumption of fossil energy, however, the food supply for consumption decreased and food price increased due to the conversion of food for bio-energy. Brazil, the largest sugar producer in the world, has developed sugarcane-based industries whose products can be sugar and ethanol biofuels with competitive fossil oil prices, which is about USD 30-40 per barrel (Schmidhuber, 2006; Muller *et al.*, 2007).

The increase of sugar prices in Brazil has influenced prices in the world market. As a result, this encourages farmers in other countries to increase sugar production and reduce production of other crops (Müller, 2006). This condition shows that the rise in oil prices will push up prices of food and

other agricultural products. Thus, energy shortages can be a threat but it can also be an opportunity to increase food production (Darma, 2012).

3. The Socio Economic Constraints

Although developing countries have a great potential for renewable energy accounting for 15 % of total world utilization of renewable energy, the use of modern renewable energy technologies currently more widely is used in industrialized countries with a percentage of 85 %. Laumanns and Reiche (2004) mention some of the main obstacles in the utilization of renewable energy sources are technology, finance, culture, and knowledge. The poor quality of the technology in producing renewable energy by some countries has led to frustration among users. For example, Indonesia has experienced of project failure of renewable energy sources utilization providing a negative portrait in the community, industry, and other users; so the enthusiasm to take advantage of renewable energy technologies have not seen significantly so far.

Financial constraints are important factors in the spread of renewable energy in developing countries. Renewable energy technology prices are not competitive compared to the price of non-renewable energy. As a result, technologies which led to the development of renewable energy have slow and static progress. In addition, the import duty for renewable energy technology had caused to be expensive for the selling prices of spare parts components. Moreover, renewable energy technology utilization scheme is widely practiced in rural areas which is predominantly low income, so the purchase price component of renewable energy technology is not a community priority

In Indonesia, culture also has become a dominant factor that affects the fuel consumption where motor vehicle is a symbol of social status and welfare indicator, so most people try to have a motor vehicle, or prefer to use a private car. Therefore, the proportion of private cars and motorcycles are very large. The number of private vehicles was 9.5 million units or 12.86 %, 68.8 million motorbike or 80.46 %, and public transportation in the form of bus and truck respectively 2.63 % and 5.79 % of the total vehicles in 2011 (Central Bureau of Statistics Indonesia, 2012). The use of personal vehicles has resulted from the benefit of fuel price subsidies causing the increase of the GHG emissions.

Environmental aspects have not been recognized by the majority of the population in Indonesia so that the low price and quality of fuels are more preferred to the people even with high carbon emissions. Residents do not know the carbon emissions resulting from the use of fuel in any activity done every day, such as the use of some electronic products and transportation.

4. Energy Consumption and Green Gas Emission

Trend of energy consumption growing phenomenon has raised various social, economic, and environmental problems. The fuel consumption of Indonesia rose over 374.691 million barrels from 2003 to 2006 (USAID Report, 2007). Economic growth and environmental preservation

efforts is a trade off because the use of fossil fuels continues to rise not only to trigger the economic growth of a nation, but also lead to climate change and environmental degradation. Energy crisis in Indonesia will be more severe than that faced by the global world because the national fossil oil reserves just enough to 18 years into the future, while domestic consumption has continued to increase with prediction of approximately 60% -70% of domestic fuel needs. This fact will make Indonesia as the largest oil importer in Asia (Chemiawan, 2010).

Fossil energy use can increase green house gas emissions and climate change. The proportion of air pollution caused by fossil energy use about 60 % of the transportation sector, about 25 % of the manufacturing industry sector, and the remaining 15 % of electricity generation (USAID, 2007). This condition will be worse because the consumption of fossil fuels for the transport sector has increased due to the growing number of vehicles and fuel prices which are cheap and the lowest in Asia as it is subsidized by the government. According to the Central Bureau of Statistics Indonesia, over the last 10 years (2002-2011), the number of vehicles (public transport, buses, trucks, and motorcycles) increased dramatically, from 20.9 million units in 2002 to 85.6 million units in 2011, an increase of approximately 31 %. The most significantly increase occurred on private vehicles in the form of passenger cars and motorcycles. The number of automobile went up from 3.4 million units in 2002 up to 9.5 million units in 2011. The motorcycles also accelerated sharply from 15.2 million units in 2001 to 68 million units in 2011 (Central Bureau of Statistics Indonesia, 2012). The public transport vehicles have also increased very high, but still lower than the private vehicles. A large number of vehicles are directly proportional to the amount of the fuel consumption in Indonesia and wasteful of fuel consumption. In 2006, fuel consumption in Indonesia reached 1.84 million barrels per day (bpd), when compared with other countries that consume fuel under 1 million bpd (Country Analysis Briefs: Indonesia 2006).

The fuel demand has continued to increase due to the growth rate of vehicles and fuel subsidies. The government has issued substantial fuel subsidies about 19 percent to Indonesia's total expenditure in 2013 (Central Bureau of Statistics Indonesia, 2013). Energy subsidies encourage excessive consumption and reduce incentives for energy efficiency. The fossil fuel consumption will certainly produce excessive GHG emissions, air pollution, and the depletion of natural resources.

The iincrease of fuel consumption tends to push the fuel subsidy. Based on data released by the Indonesian Transportation Society, fuel consumption in 2010 amounted to Rp165.2 trillion was allocated for public transportation only about Rp 4.8 trillion and goods car accounted for Rp 6 trillion. Meanwhile motorcycles spent over Rp 64.3 trillion and Rp 85 trillion for private cars. In addition, fuel subsidies in 2012 was Rp234.2 trillion. From these figures, public transport consumed only Rp 6.8 trillion, Rp 9.1 trillion for freight cars, while private vehicles up to Rp 212 trillion subsidy drain consisting of motorcycles just over Rp 91.2 trillion and private cars Rp 120.8 trillion (Ministry Energy and Natural Resource of Indonesia).

The volume of subsidized fuel was set at 40 mil kilo liters in 2012. In fact, consumption reached 45.2 million kilo liters due to less successful control of polices. The 2013 National Budget has been set by the government energy subsidies expenditure amounted to Rp 274.7 billion with details of fuel subsidy Rp193.8 trillion and electricity subsidies Rp 80.9 trillion, with a volume of 46 million kilo liters (Ministry Energy and Natural Resource of Indonesia). The government issued a substantial budget for fuel subsidies, amounting to 19 percent of the total budget in 2013.

However, the subsidy has been mostly enjoyed by the high-income people. Approximately 40 % of high-income people consume 84 % of subsidized fuel, and the richest 10 % of consumer's fuel consumed nearly 40 % of the total subsidized fuel. In contrast, less than 1 % of the total subsidized fuel used by the poor (World Bank, 2011). Thus, the benefits of fuel subsidy are mostly enjoyed by high-income groups, while the cost of subsidy to be borne by all tax-payers.

As a result, the fuels subsidies are regressive policy, which makes the poor pay more and receive smaller benefits than high-income people. That is to say, reduction or elimination of fuel subsidies will increase the prices of fuel and goods and inflation, so it will affect the purchasing power of people, especially those living below the regional minimum wage. In order to avoid the negative impact of subsidy removal and high oil prices, the government expenditure should be increased for social sectors (Clements *et al*., 2007).

Another factor that causes an increase of fuel consumption is the condition of public road infrastructure. Road infrastructure, public transport, and transportation system make excessive fuel consumption of about 30 % (Central Bureau of Statistics Indonesia, 2012). Nationally, total inland vehicles are the predominant mode of transport in Indonesia, accounting for 70 % of total freight ton and 82 % of passenger. Today, the total classified road network is reported to be over 477,000. It attracts 40 % of total infrastructure spending and represents an asset value equivalent to more than 15 % of Indonesia's GDP. The good quality of road is about 25.99 %, and the rest is bad condition. It happened because 80 % of the total road is authorized by district level which has limited budget for road maintenance (Country Analysis Briefs Indonesia, 2006).

Vehicle road infrastructure and transport system are very bad causing people tend to use a personal vehicle. There are no age restrictions on the technical use of vehicles in Indonesia so the number of vehicles continues to increase. The proportion of older age vehicles that produce high carbon emissions remains grow. This condition makes the fuel consumption continues to rise and simultaneously generate pollutants that damage the environment, especially in urban areas. The situation worsens due to no regular emissions inspection and maintenance.

5. The Development of Fossil Fuel Substitution

Furthermore**,** electricity demand has increased significantly in Indonesia in recent years. The total energy consumption of Indonesia increased approximately 300,147 GWh in 1980, 625,500 GWh in 1990,

1,123,928 GWh in 2000 and 1,490,892 GWh in 2009 with an average increase of 2.9% (Silitonga *et al*., 2011). The electricity generation accounts for nearly two-thirds of the 2,010 total coal sales. The demand for coal will increase two-fold as a result of the additional capacity of coal-fired generation by 2014 (EIA, 2006a). The capacity production and the availability of domestic coal is relatively abundant. The amount of coal is estimated at 36.3 billion tons of reserves, but 50-85% of them are low-quality (EIA, 2006b). To get a good coal, it needs to be mixed with high-quality coal import from several countries.

Moreover, the Indonesian government has encouraged increasing the use of coal in the electricity sector as domestic supply because it is relatively abundant and it is a way to reduce the use of expensive diesel and fuel oil. Although coal consumption has grown significantly in the last decade, most of the coal production has been exported. Over the last decade, electricity generator from coal generated approximately 86.69 % and approximately 13.31 % is generated by renewable energy such as hydropower and geothermal by 2009 (Hasan *et al*., 2011).

The Indonesian government has controlled the price of domestic oil products so that the fuel prices are lower than the world price with providing a subsidy. Beside that, the government also has controlled electricty price which is lower than the cost of production by subsidising the national electricity company. With the lower fuel and electricity prices, the market price has resulted in a heavy reliance on the use of fuel. The share of fuel in the energy mix is very dominant. This policy also has hampered conservation programs and energy diversification.

The fuel subsidies also reduce the incentive to undertake investments in bio energy sources and cleaner technologies, although Indonesia has abundant of natural resources, the fuel subsidies hinder new discoveries in the production and supply of other eco-friendly energies, such as solar energy, biofuel, natural, geothermal, and so on. According to International Energy Agency, if the Indonesian government eliminate the subsidies for fossil fuel consumption between 2012 and 2020, it will reduce global CO2 emissions by as much as 5.8 %, compared to if consumption continued as usual (IEA, 2010). Meanwhile, the OECD estimates that emission reductions could reach 10 percent by 2050 if the same subsidies for fossil fuel consumption can be stopped by 2020 (IEA, 2010). The rremoval of subsidies on fossil fuels will contribute to reduce GHG emissions without having to implement a carbon tax or emissions trading system. Yusuf *et al*. (2010) found that cutting fuel subsidies will reduce national CO^2 emissions level of spending as much as 6.71 % in 2020.

Development of biofuels from food commodities is an alternative energy source, but the local food development suggested to be developed based on a wide range of commodities and food products, instead of changing the energy source. As for the development of biofuel energy is advised to use as alternative sources of renewable energy from non-food commodities which is available in Indonesia. Anticipation of the energy crisis can be done through the development of alternative energy sources

such as biogas, Solar Power Plant, the use of micro-hydro technology, and other utilization of alternative energy sources. However, the conversion of food to energy commodities biofuel should be done carefully, systematically and gradually so it will not disturb the stability of the national food.

6. Food Crisis

Food and energy crisis are presently serious threat being faced by domestic and world because of increasing demand which is beyond food supplies, and increasing energy which results in an increase price of these two commodities. The efforts of increase production presently could potentially lead to environmental degradation and the decline in biodiversity because the principle of 'green economy' has not been applied. Food is a global problem since the 90s and a topic of discussion in various international forums (such as the International Conference of Nutrition, the World Food Summit in 1996). One of the important decisions is to produce food as a basic right, in which each resident has the right to adequate food and freedom from hunger (FAO, 1996).

However it emphasizes on the availability without regarding to how to meet, so the food supply can be carried out through liberal trading activities. This condition makes the international trade of food as very profitable commodities. Lack of control by the state has led to very monopoly food trade structure so that 90% of trade in food (cereals) is controlled by only five multi-national companies (MNC). Similarly, 90% of the seeds and agricultural inputs (pesticides and herbicides) markets, and 99.9% of GM seeds are controlled by only six MNCs. When the food crisis hit the world in 2008, world trade gained 55-189% of food, 21-54% of seed and herbicide, and 186-1200 percent of fertilizer compared to the previous year (Santosa, 2008). This condition is the impact of the various agreements of international organizations (WTO, FAO, WFP, etc.) and regional cooperation (AFTA, NAFTA, EEC, AEC, etc.) that formulate the rules of world trade in adverse developing countries to reduce state supports in the agricultural sector as an increase market access for agricultural imports as well as decrease agricultural export subsidies.

Phenomena occurred in Indonesia is quite high number of poor people and the increase of various types of imported foods. Therefore, if the purpose of development is still oriented to the availability of food production and consumption, then Indonesia will far behind other countries. While food commodities have become a "belle commodities" and even developed "food traps" (Salman, 2012) with the victims of state-food-importing are dominated by developing countries.

Indonesia, an agricultural and the most populous countries, which vision is food fulfillment self-sufficiency of local food (Salman, 2012), can be developed as a highly competitive with the great potential in the form of local food, culture, technology development, and liberalization of food trade, all of which encourage the development of Indonesian food in the global era. Based on this reality, the concept of food security is more profitable for developed countries

through trade liberalization, which the state is obliged to fulfill the rights of food for its people to make food easily traded. Various programs or movements performed in order to achieve food security in Indonesia, such as household food security, diversification, development of local food, etc. However, all of these concepts are very slow implementation and become meaningless which are crushed by the stream of trade liberalization. Consequently, the food development in the country does not improve the competitiveness.

In fact, many food programs tend to reductionism that led farmers depend on external input (commercial inputs), while their farm system is subsistence, so the Farmers Term of Trade of food is still low. Indonesia's food security index was ranked 64th out of 105 countries with a score below 50 on a 0-100 score postscript which worse compared with neighboring countries such as Malaysia, Vietnam, and the Philippines. Indonesia also is one of the groups of countries with serious food crisis with Mongolia with indices ranging from 10.0 to 19.9 (Khudori, 2013).

Indonesia can be a food sovereign state through the development of agriculture because agriculture is a way of life as well as culture for most farmers with a lot of available land that has not been managed optimally to its potential. Based on BPN (National Land Board) data, Indonesia still has about 7.3 million hectare available vacant land that potential for agricultural activities (Khudori, 2013). Utilization of idle land in addition to meet domestic food needs can also reduce the number of small farmers, even with the industrialization of food can make Indonesia as an exporter of food.

7. Food Industrialization as an Economic Movement

Food should be developed beyond the mere production and consumption or moving beyond the food and serve as a social movement as a topic discussed not only by politicians and academicians, but also all elements of society. Food Industrialization is an indicator of the development performance, such as food product diversification, increased value-added, environmentally friendly products, advances in processing technology, cultivation, marketing system, employment opportunities, and so on.

Industrialization of food as an economic mover is the train of different types of business activities with a variety of products and services that generate value added and competitiveness. It creates the multiplier effects of income and employment, as well as strong drivers of economic development. Food enterprises as industry component are input-based industry, cultivation, harvesting, processing, marketing, and support services activities. Coconut-based industries have developed in Indonesia with over 25 kinds of products. It is still smaller then compared to Philippines that have reached over 125 kinds of products and also dominate world exports refined oil products (Kompas, 2007).

Household scale sugarcane-based industry has started to be developed in South Sulawesi with the complement of appropriate technology, such as the squeeze machine and energy efficient of stoves. People can cultivate sugar cane to produce

a variety of products such as brown sugar, palm sugar, molasses, and wastes as the input for cattle then resulting meat, milk, manure, organic fertilizer, and biogas (Darma *et al.*, 2012). Industrialization of sugarcane is expected to produce a variety of environmental friendly products that demand is increasing in the modern era as import substitution or export commodities. There are many food commodities could also support the development of small and medium scale enterprise (SMEs) as the main players of food industry. SMEs as the backbone of the economy of Indonesia as labor-intensive industry provides huge of employment and output. The number of SMEs in 2011 approximately 52.8 million and absorbing labor of 101.72 million people by contributing 57.94 percent or bigger than big company counted 42.06 percent of GDP (Hening, 2013). SMEs have also proved resistant to the economic crisis, even a lifesaver national economics at the time of the economic crisis in Indonesia in 1998, including the global economic crisis that hit the developed world in recent years.

8. Local Food Development for Sustainable Development

Products with the specific nature of the locality become more competitive in the global era with a very broad arena of competition and very limited or almost no similar products produced from other sites. Food and energy products with specific/ local endowment are found in many sites in Indonesia because they are supported by a variety of endowment. It is believed that the development of endowment owned by state increasingly providing the bargaining position in the global market. Globalization should be understood as a change of information from very expensive to be cheaper. Specific product (unique) becomes more expensive because from the very few to a lot of people know the specific product as a result of information services. This condition is supported by information and communication technology (ICT) Limited production with a lot of demand due to globalization has the competitive advantage.

Many areas are developing more advanced and modern because they are able to manage the local potency. For example, the Island of Bali is more widely known in world community than Indonesia. The products of *Luwak* coffee and *Kalosi Arabica* Coffee popular and traditional feast of death of Toraja community are very popular than Indonesia as the one of largest producer of cocoa in the world.

In 1960, Indonesia was considered a low developing nation with poor basic needs. This condition has changed since the late 1980s after Indonesia has became the importer of rice, and aware that the a nutritional balance of food is important, not predominantly of carbohydrates originating from rice so that the diversification of food began to be promoted. Two of these circumstances make the diversification of food as one of the issues of agricultural development. This is very basic, the non rice-based staple food is a traditional staple food for most Indonesian people, such as tubers, sago, banana and some cereal crops (mainly corn), which is supported by the availability of animal protein, fresh water aquatic, and the sea. This food is available locally and it grows traditionally as culture commodity.

It is not affected by climate change like the *el- nino* and *la-nino*, including the change of seasons, so food self-sufficiency can be realized. The basic food as basic needs could be easily developed as local economic resources development as well as a largest part of agricultural development which could be developed as a local unit food industry belt in rural area. Rural development could be done by self-supporting through the strengthening of local organization function with a set of norms and supported by available resources.

9. Conclusion

One of the causes of the increasing of green house effect (GHE) in Indonesia is the consumption of fossil fuels that continues to increase along with the population and economic growth. Both developments encourage to the use of transportation, especially cars, motorcycles, and power consumption energy which boost the increased-use of fossil fuels very sharply over the last decade. Inefficiency in the use of fuel due to the fuel subsidies has increased the level of congestion in the city such as urbanization, road conditions, low quality, and low fuel prices. The cheap fuel prices also inhibit "blue sky" environmental movement and the conversion from fossil fuels to bio fuels. Food insecurity has threatened Indonesia where various imported food products continue to increase. As a result, the diversification efforts are needed for encouraging people to return to non-rice local food eating that has huge potential and resist to the climate change. In addition, the developing of biofuels by utilizing idle land would create employment, output, and simultaneously reduce the greenhouse effect. Climate change adaptation on food diversification for food sovereignty in Indonesia could be encouraged through promoting the food industrialization and local food movement to encourage the preservation of the environment and conservation of natural resources.

References

1. Burniaux, J., and Chateau, J. (2011). "Mitigation Potential of Removing Fossil Fuel Subsidies: A General Equilibrium Assessment." OECD Economics Department Working Papers, No. 853, OECD Publishing. doi: 10.1787/5kgdx1jr2plp-en.
2. Central Bureau of Statistics Indonesia (series: 2010,2011, 2012, 2013) . www.bps.go.id
3. Chemiawan, T. (2010). The Continuation of the Global Energy Crisis, Downloaded from: http://t_sarianti.staff.ipb.ac.id/2010/05/19/bioetanol/).
4. Clements, B., Jung, H-S. and Gupta, S. (2007). "Real and Distributive Effects of Petroleum Price Liberalization: The case of Indonesia." The Developing Economies 45(2): 220–237.
5. Country Analysis Briefs: Indonesia. (2006). http://www.eia.doe.gov/emeu/cabs/Indonesia/Background.html. Energy Information Administration, Department of Energy.
6. Darma, R., N.A. Teriawaru, dan M. A. Sallatu, (2013). Brown Cane Sugar–Cattle Integratias a Rural Economic Mover. National Seminar on Economic Creative, jointly organized by Association of Indonesian Agricultural

Economics (PERHEPI), Univesity of Sebelas Maret (UNS), Surakarta, 26 Januari 2013.

7. FAO, (2006), World agriculture: towards 2030/2050, Interim report, FAO, Rome.
8. Hasan, M.H., Muzammil, W.K., Mahlia, T.M.I., Janifar, A., and Hasauddin I. (2011). "A Review on The Pattern of Electricity Generation and Emission in Indonesia from 1987 to 2009". Renewable and Sustainable Energy Reviews 16 (2011): 1-2. doi:10.1016/j.rser.2012.01.075
9. Hening, Y., (2013). The contribution of SMEs to Indonesian Nasional Economy. Downloaded from: http://yasintahening.wordpress.com/2013/03/ 27/kontribusi-umkm-dalam-perekonomian-indonesia/
10. Hudori, (2013). Interpret FAO Award . Kompas, Daily Newspaper, Wednesday, 31 July 2013.
11. IEA, (2006a), Key World Energy Statistics – 2006 edition, International Energy Agency, Paris.
12. IEA, (2006b), World Energy Outlook 2006, International Energy Agency, Paris.
13. IEA. (2010). World Energy Outlook 2010. Paris: OECD.
14. Koch, J., Dayan, U., and Marom, M. (2000). "Inventory of Emission of Greenhouse Gases." Journal of Water, Air, and Soil Pollution 123(2000): 259-271.
15. Marten, G. (2005). "Environmental Tipping Points: A New Paradigm for Restoring Ecological Security." Journal of Policy Studies 20 (July 2005): 75-87. http://www.ecotippingpoints.org/resour-ces/download-pdf/publication-journal-of-policy-studies.pdf
16. Meadows, Donella. (1999). Leverage Points: Places to Intervene in a System. Hartland VT: The Sustainability Institute. http: //www.donellameadows.org/wp-content/userfiles/Leverage Points.pdf
17. Ministry Energy and Natural Resource of Indonesia. www.esdm.go.id
18. Muller, A., Schmidhuber, J., Hoogeveen, J. Steduto, P. (2007). Some insights in the effect of growing bio-energy demand on global food security and natural resources. Paper presented at the International Conference: "Linkages between Energy and Water Management for Agriculture in Developing Countries", Hyderabad, India, pp: 28-31
19. Müller, A. (2006). Competition between food and non-food uses presented at: Economic diversification, food security and the interlinkages between the agricultural and the energy sector - Expert meeting, 29. November-1. December, 2006 Geneva, Palais des Nations
20. Salman, D., (2012), "Food for People: Against deprivation and Irrationality ", in, A. Fariyanti et al (Eds.), Food People: The Life or Dye in the after 60 year problems. FEM-IPB and PERHEPI. pp. 91-102
21. Santosa, D. A. (2008). Food Security Vs. Food Sovereignty, Kompas Newspaper, 13 January 2008
22. Schmidhuber, J. (2006). Impact of an increased biomass use on agricultural markets, prices and food security: A longer-term perspective. Paper presented at a conference organized

by Notre Europe, Paris, November. Retrieved from: http://www.fao.org/es/ESD/Biomass Notre Europe.pdf)

23. Silitonga, A.S., A.E. Atabani, T.M.I. Mahlia, H.H. Masjuki, Badruddin Irfan Anjum, and S. Mekhilef. (2011). "A Review on Prospect of Jatropha curcas for Biodiesel in Indonesia". Renewable and Sustainable Energy Reviews 16 (2011): 1-4. doi:10.1016/j.rser.2011.07.011
24. Soehodho, S. (2008). "Determination of Urban Transport Policy in Indonesia." http://www.thredbo-conference-series.org/downloads/thredbo6_papers/Thredbo6-theme4-Soehodho.pdf
25. Tanaka, B. (2008). Up To 2030, World energy demand increases 45 %. Downloaded from :http://www.esdm.go.id/berita/umum/37-umum/2133-hingga-2030-permintaan-energi-dunia-meningkat-45-.html
26. USAID, (2007). Country Analysis Briefs: Indonesia. 2006.
27. USAID, (2007). Indonesia Country Report: From Ideas to Action: Clean Energy Solutions for Asia to Address Climate Change. http://www.eia.gov/countries/analysisbriefs/Indonesia/indonesia.pdf
28. World Bank. (2007). Spending for Development: Making the Most of Indonesia's New Opportunities. Indonesia Public Expenditure Review 2007. Washington D.C. https://openknowledge.worldbank.org/bitstream/handle/PUBLIC1.pdf?sequence=1
29. World Bank. (2011). Conditional Cash Transfers: Reducing Present and Future Poverty. Washington: The World Bank. http://www.google.com.au/url?q=http://siteresources.worldbank.org/INTCCT/Resources/5757608-1234228266004/PRR
30. Yusuf, A. A., Komarulzaman, A., Hermawan, W., Hartono, D. & Sjahrir, K. R., (2010). Scenarios for climate change mitigation from the energy sector in Indonesia: Role of fiscal instruments. Working Paper No. 201005. Bandung: Padjadjaran University.

***